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HAZARDOUS WASTE REMEDIAL ACTION — PICILLO FARM, COVENTRY, RHODE ISLAND; AN OVERVIEW

BARRY W. MULLER, ALAN R. BRODD and JOHN P. LEO

Rhode Island Department of Environmental Management, Division of Air And Hazardous Materials, Providence RI 02908 (U.S.A.)

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Summary

Following the discovery of buried chemical wastes which caused a fire and explosion at the Picillo Farm in Coventry, Rhode Island, the State of Rhode Island began legal, administrative and technical action towards cleanup.

A hydrogeological site investigation was conducted which included ground and surface water monitoring, seismic studies and ground penetrating radar. Four discrete trenches of buried wastes were identified. It was decided, due to both funding and geographical limitations, that a phased cleanup approach be conducted.

Cleanup of the first trench began in summer 1980 and concluded that fall, with 2300 barrels being removed. Planning for the second trench excavation and disposal commenced in October of 1980.

In November 1980, invitation to bid on the excavation and disposal of barrels from the so called northwest trench was requested. When the U.S. EPA offered to fund the excavation of the wastes, EPA and the State entered into a joint venture in the cleanup, with the State to bear responsibility and costs of proper waste disposal. Plans continued towards that end until March 1981 when federal funding was curtailed.

Subsequently, Rhode Island decided to assume the excavation portion of the project and dispose of the wastes as far as funding would allow. Mobilization of equipment and personnel, as well as site preparations, were commenced and excavation activities began in mid-April 1981.

In the excavation phase of the work effort, a total of 4400 barrels of hazardous wastes were removed: 40% contained liquid hazardous waste, 40% solid hazardous waste and the remainder empty. As of this date, efforts to dispose of the waste continues.

Site preparation, placement of work areas, excavation and waste transfer techniques, air quality monitoring and operational problem areas are among topics of hazardous waste cleanup requirements discussed. Analytical problems and laboratory requirements pose unique problems vis a vis disposal criteria required by licensed waste disposal facilities.

This paper addresses the chronology of events which took place during the 1981 cleanup efforts, comments upon the variety of problems encountered and discusses the unique considerations faced in abandoned hazardous waste site cleanup.

History

In the fall of 1977 an explosion and fire alerted area residents and officials to the presence of a chemical dump site at the Warren V. Picillo Farm (Fig. 1).

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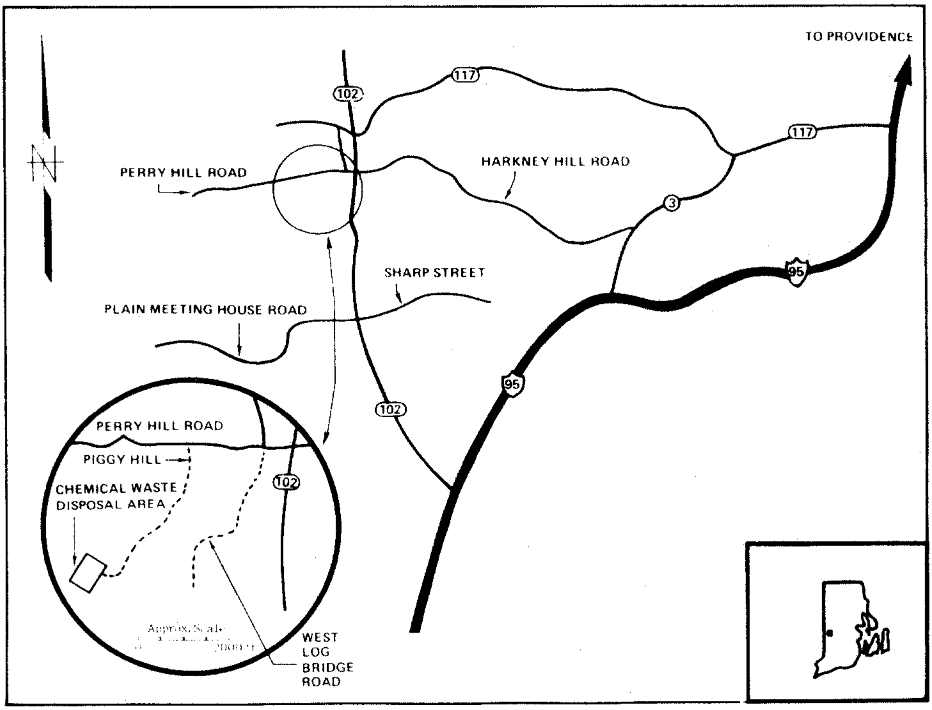

Fig. 1 Location of Picillo Farm, Coventry, Rhode Island.

The Rhode Island Attorney General sued to enjoin Picillo from further disposal and to remove all hazardous wastes for proper disposal. The State attempted to secure legitimate disposal outlets for these wastes. When Picillo failed to comply with the court order, the Attorney General became involved in a lengthy court action which continues to this day.

Phase I

In late 1978 the Rhode Island General Assembly passed an emergency appropriation to begin cleanup activities at the site. The Rhose Island Department of Environmental Management (RIDEM) retained the services of a consultant to conduct a hydrogeological assessment of groundwater contamination, assess the extent of wastes buried onsite and develop remedial options for resolution of the problem.

The options evaluated for remedial action included:

Encapsulation of the site

This option considered the placement of an impermeable cover over and wall around the site to bedrock. It was rejected for the reasons that (1) significant sources of chemicals would remain in a liquid state as they were contained in deteriorating barrels, (2) the bedrock depth varied between

25 and 35 feet which would be costly insofar as liner placement was concerned and (3) the bedrock beneath the site is highly fractured, i.e. too permeable for a secure base.

Interceptor trenches

This option considered the placement of trenches down gradient from groundwater and leachate flow. It was rejected for the same reasons, i.e. deep bedrock, irregular bedrock surface and fractured bedrock.

No action

This alternative was examined since a swamp directly northwest of the site was found to contain significant quantities of leachate and acted as a "filter" or point of volatilization of many organics. It was rejected as the swamp could not be proven to be an adequate treatment mechanism for all wastes. Further, no control over this "mechanism" could be exerted since the disposal site itself contains a significant source and quantity of chemical wastes. In a purely social sense, the option of no action was ill-advised and posed significant consequences.

Drum and chemical removal

This alternative was considered to be the only viable one as it would insure the source of contaminants would be removed. Further dispersion of contaminants in the groundwater could be monitored. Following receipt of the consultant's recommendations, it was decided to excavate and dispose of all barrelled wastes and contaminated soil. In the spring of 1980, the RIDEM contracted to excavate the contents of the northeast treanch, which was thought to be one of the smaller trenches (Fig. 2 — Map of site with trenches). Ground penetrating radar and metal detection surveys had been utilized to determine the extent of the trenches [1]. Unfortunately, these techniques could not predict either density of barrels or depth of the trench. When the excavation was completed, the depth from grade was 35 feet and the trench contained 2300 barrels of wastes as compared to an estimate of 270 barrels.

It appeared from the condition of the barrels that this had been one of oldest trenches, since most barrels were leaking as they were removed. Many barrels in the upper layers had been crushed, which had generated large pools of leachate. Several important lessons were learned from this first excavation.

(a) Barrels were allowed to leak during removal causing additional contamination of the soil. This soil which is contaminated with PCB's still poses a significant disposal problem.

(b) The State let a lump sum agreement contract for a specific number of barrels thought to be contained in the trench. When it was discovered that the amount of waste far exceeded the forecast, delays were encountered until additional funding could be procured. The lump sum agreement form was altered to a time and materials format.

(c) It was decided to combine the contents of many barrels of similar flammable wastes in the tanker prior to thorough final analysis. The result was 4000 gallons of wastes contaminated with PCB levels in excess of 1500 ppm.

Phase II

Following completion of disposal of the northeast trench wastes in the fall of 1980, RIDEM began planning for excavation of the northwest trench (Fig. 2). It was known from the metal detection survey and ground penetrating radar studies that the trench extended for 250 ft and at its widest was 50 ft. From previous experience in the northeast trench, the revised estimates for barrel content ranged from 8200 to 22,400 drums.

A Scope Of Work and Request For Proposal for excavation and disposal was distributed in November, 1980. It specifically requested a response to the technical issues of drum removal, encountering leaking barrels, contaminated soil, site layout, personnel protection, site decontamination zones and safety requirements.

Further requirements to be addressed included drum staging following subsurface removal, at which time leaking drums would be repackaged and records initiated. Other areas to be addressed were drum waste classification, sample analysis, onsite treatment, disposal, record keeping and reporting and surface water infiltration. All interested bidders were directed to respond not later than mid November. However, in early December the United Stated Environmental Protection Agency (EPA) announced that they had money available to fund the excavation portion of the project if the State would assume responsibility for disposal of the waste. The State agreed to this option and transferred all bids to EPA for evaluation. The State examined its bids for disposal capability and selected a contractor to perform disposal activities. EPA chose another contractor to conduct excavation activity. In early February, 1981, EPA began site preparation by constructing several diked storage and staging areas placed so as to effect an orderly material flow from the trench excavation area to the pumping/staging area to final storage prior to disposal (Fig. 3). EPA constructed several areas in which a polyethylene liner was placed beneath the soil surface to prevent infiltration of chemical wastes from leaking or spilled drums. By the end of February, project mobilization was begun. Office trailers, a decontamination trailer, supplies and equipment were brought on site. However, EPA advised the State in mid March that anticipated funding was not available and it would have to terminate its contract. The State decided to assume the excavation portion and dispose of as much waste as possible within its own funding constraints. RIDEM began preparation for the excavation requirements and mobilized all remaining equipment necessary on site. In mid-April actual barrel removal began.

The excavation of barrels from the northwest trench proceeded until the end of June, 1981 by which time 4400 barrels of wastes had been removed

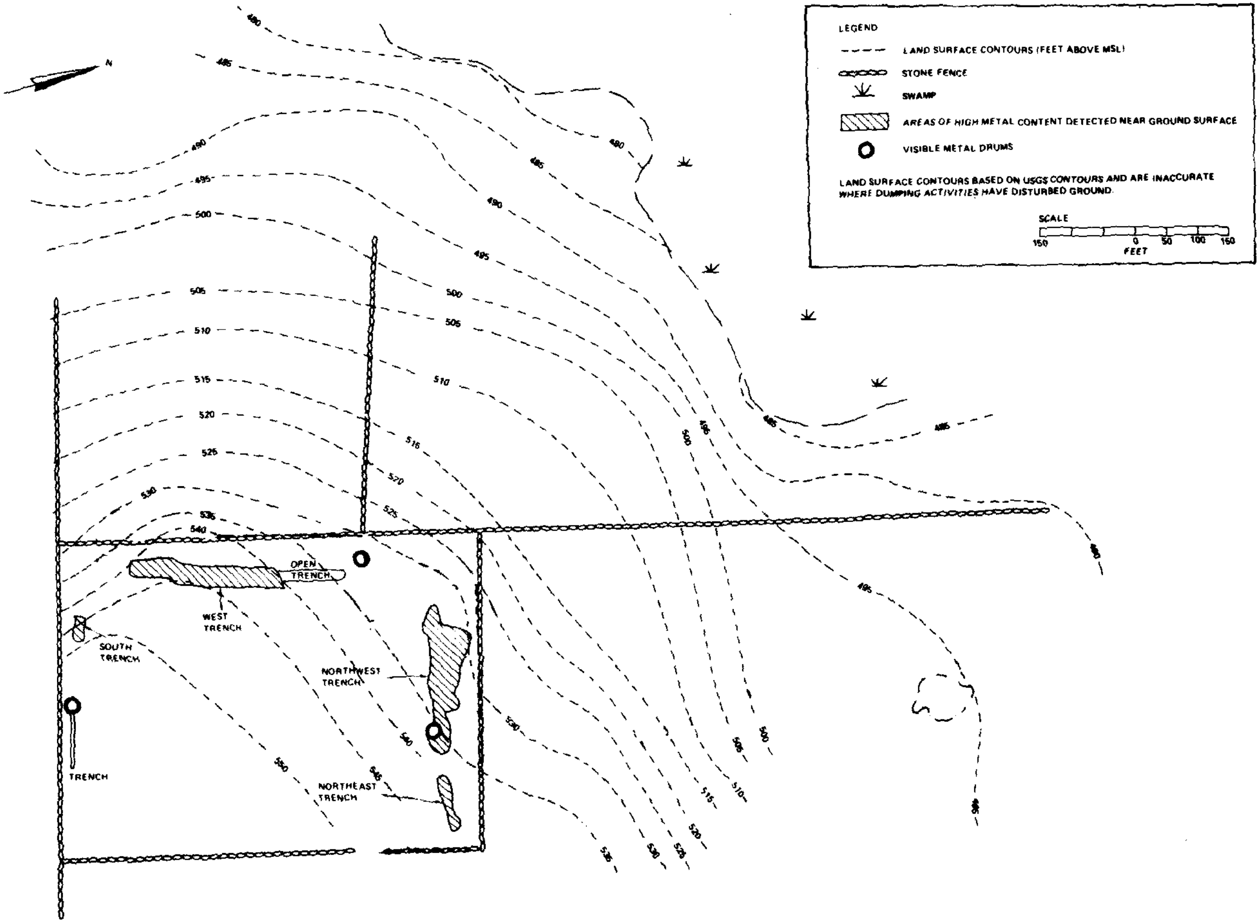

Fig. 2 Location of disposal trenches.

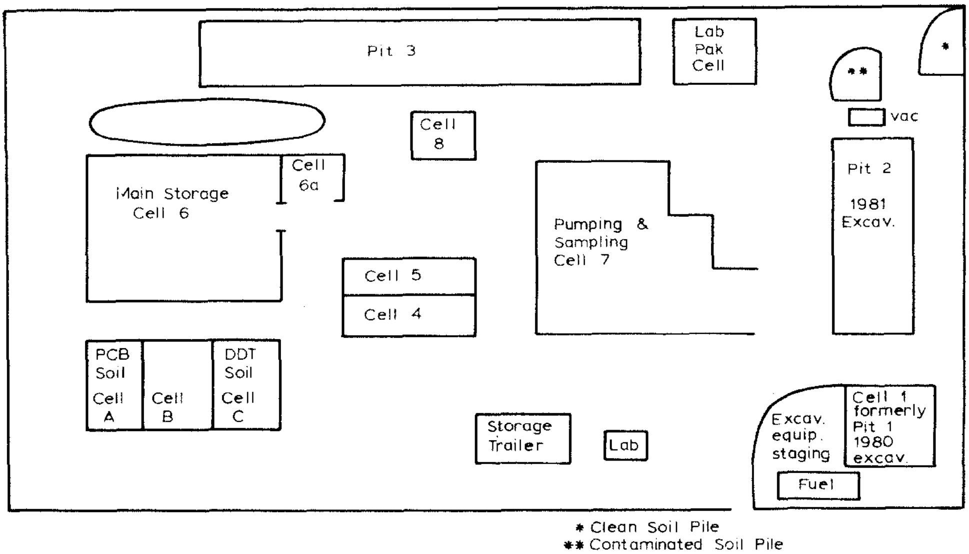

Fig. 3 Operational layout of northwest trench excavation.

and stored on site. At that point over $800,000 had been expended, necessitating a curtailment in disposal options. It was estimated that it would cost at least $500,000 to dispose of all the excavated hazardous wastes on site. Continued funding of this effort became a problem as the State would commit only $1,000,000 to the job. EPA obtained emergency funding of $250,000 to dispose of the hazardous liquid materials stored on site. There were approximately 1800 barrels of liquid wastes and 2600 barrels of solids material. By September, 1981 all but 190 barrels of liquid wastes had been disposed of with available funds. Recently it has been learned that EPA has obtained $410,000 of emergency Superfund money to dispose of the remaining hazardous wastes from the northwest trench.

The remaining discussion will detail barrel removal and analysis, air monitoring requirements and problems encountered in the excavation phase of the job.

Barrel handling and analysis

The procedures for barrel removal and staging were discussed with contractor and subcontractor personnel and thoroughly understood prior to movement. As a barrel was unearthed, it was transferred by backhoe to the pit staging area and examined for identifying markings or labels. Any barrels containing such markings were held asite as potential evidence drums.

Transfer of contents

If the barrel was leaking, it was tranferred to an overpack drum. Along with other non-leaking drums, they were examined for physical state. Based on this preliminary examanination, the barrels were transported by front-end loader to a liquid storage area, solid storage area, sludge storage area or the liquid repumping area (Fig. 3). The sole purpose of the repumping area was to transfer the liquid contents into secure drums. Leaking drums, which had been placed inside overpacks in the pit area, were transferred into new or reconditioned steel drums. The barrel was moved into a storage area. Before sealing the drum, the pumping crew sampled the contents. The sample jar was left on top of the barrel until the end of the working day when the drum was numbered, the accompanying sample given the same number, and the samples were collected for analysis.

After the contents were transferred from a leaking drum, it was inspected for residual materials content. If a significant amount of solids remained in the drum, it was transferred to the solids holding area. If not, the barrel was transferred to the empty drum pile to be crushed and disposed of properly.

Acid drums were repumped into polyethylene lined drums for storage. A sample of each acid waste was taken by the pumping crew and was left on the drum with the drum pH marked on both drum and sample container. Both drum and samples were handled the same way as noted above.

Storage

Liquids

All non-leaking liquid barrels extracted from the trench were directly transferred to the liquid storage area. A three man sampling crew opened each drum, sampled the contents and closed or secured the drum from the weather.

Each drum was sampled with a hollow 3/4 in. diameter glass tube to allow a composite sample of the barrel. To avoid cross contamination of the samples, a separate tube was used for each barrel. As the samples were taken, characteristics of each were noted on a separate card. A number was assigned to each barrel and sample.

Solids

As each drum containing solids material was extracted from the trench, it was transferred to a secure solids storage area. Samples were extracted from several drums with a disposable scoop and delivered to the laboratory for analysis.

Sludge

Non-pumpable liquids or sludges from the repumping area were staged in a sludge holding area when extracted from the trench. The glass tube was used for sampling if possible, or a disposable scoop was used. Sample were collected numbered in the same manner as the liquids and held pending collection for analysis. During the sample procedure, all wastes (solid, sludge and liquid) were examined and physical characteristics were noted (e.g., odor, fuming, color, etc.).

Field laboratory analysis

Liquids

Upon delivery of liquid samples to the field lab, samples were first examined for the previously noted physical characteristics (odor, fuming) to insure the protection of the personnel involved. All liquid and sludge samples were checked for pH. Those with a pH less than 3 were considered to be acid; those greater than 12, base. Following the test, a flammability analysis using a portable flammability tester was conducted. By hazardous waste regulation, if such test shows the material has a flash point of less than 140°F it is considered to be flammable.

Following this test, water reactivity was examined by dropping a minute quantity of the sample into distilled water.

Specific gravity was examined and samples were isolated into three groups: those with specific gravity less than 0.9; those with specific gravity ranging from 0.9 to 1.1; and those with specific gravity greater than 1.1.

Following the specific gravity analysis, all samples with pH greater than 9 were checked for the presence of cyanide.

Acids were examined for reduction/oxidation potential which measures the ability of an acid to be a reducer (water reactive) or an oxidizer (which when mixed with organics could cause an explosion). As an example, perchloric acid, a strong oxidizing acid, if mixed with a grease or oil forms an explosive mixture.

Physical characterists such as fuming or sublimation were noted on the work sheets for those samples.

Solids

Upon receipt of solids samples in the field laboratory, samples were examined for extraordinary physical characteristics, e.g. fuming, odor, etc.. Following this, distilled water was utilized to dissolve the solid, if possible, and pH was checked, obviously, if water reactivity was a problem, it was noted in this phase. A portion of the mixture was then examined for cyanide and flammability/combustibility capability.

Based upon the preliminary field analysis for both solids and liquids, drums were segregated into preliminary compatible groups (e.g., flammable, nonflammable, acid, caustic, etc.). This required movement of non-leaking drums from the initial staging area to the compatible group area in the main storage cell.

Off-site laboratory analysis

Once the field laboratory investigation was completed, samples were transferred to an off-site independent laboratory. This lab provided the capability for a full disposal analysis on compatible groups of samples. It was the intention to bulk as many compatible liquids as possible for disposal purposes to enable the most cost-effective means of disposal.

The off-site lab verified the field anlaysis to insure that in combination no violent reaction would occur. Once a significant group of compatible samples was developed (representing 80 to 100 barrels), a PCB analysis was conducted on subgroups (generally five drums). This proved to be the most time consuming, costly but necessary analytical task.

PCB contamination poses difficult and expensive disposal options whenever concentrations exceed 50 ppm. When a five barrel composite showed significant PCB contamination (>50 ppm), each uncombined sample would be examined individually for contamination. As can be imagined, this was a time consuming task which posed significant problems in turnaround time for composite analyses.

However, once a compatible group of samples had all PCB barrels identified and removed from the composite, a final disposal analysis on the remaining barrels was conducted. Combined with all preliminary tests, the disposal analysis consisted of those tests shown in Table 1. In comparing the analytical requirements of a variety of disposal facilities, these tests (Table 1) represent the analyses necessary prior to acceptance of unknown materials for disposal.

TABLE 1

Analytical requirements for disposal

1. Flammability
2. pH
3. Specific gravity
4. PCB analysis
5. Heat content (BTU's)
6. Physical state at 70°F
7. Phases (layering in liquids)
8. % solids
9. Hydrocarbon composition
10. Pesticide analysis
11. Sulfur content
12. Phenols
13. % oil and grease
14. % water
15. Viscosity
16. Organo-chlorine percentage
17. Metals analysis
    a. Liquids were analyzed for soluble metals.
    b. Solids were extracted according to the EPA Toxicant Extraction Procedure (24 h) which shows leachable metals.
    c. Both liquid and solids were checked for concentrations of the following metals:

Arsenic	Mercury
Barium	Nickel
Cadmium	Selenium
Chromium	Silver
Copper	Zinc
Lead	

18. Both free and total cyanide content were checked.
19. Solids were checked for solubility in water, sulfuric acid and dimethyl sulfoxide.

Air/safety hazard monitoring

As a result of improper storage, an unauthorized hazardous waste disposal facility can be a source of significant odors. In the Picillo case, an ongoing air pollution incident is created as a result of barrel excavation. Leaking or open barrels, pooled leachate, pumping and transfer operations and the storage of wastes awaiting disposal all contribute to the creation of objectionable odors. The generation of odors creates problems from both a worker and community standpoint. While worker exposure was limited as far as possible with protective/respiratory equipment, community complaints occurred throughout the excavation and disposal operations.

Monitoring program [2]

In the spring of 1981, an on-site pollutant monitoring program was designed and implemented to provide a continuing objective assessment of the hazards to life and health of all personnel participating in the cleanup operations. The purpose of the assessment was to provide an assurance that personnel protection and fire and/or explosion protection were sufficient and that the "clean" areas on site were indeed clean.

The focus of this program was on-site operations. First, higher concentrations of contaminants would be encountered which would pose a greater threat as well as facilitating more reliable measurements. Second, the logistics of on-site sampling were easier to consider with respect to placement of monitors and the effects of local meteorology and topography on air contaminant movement.

The monitoring program was designed in three phases to provide:

(1) Scientifically sound identification of the chemical hazards over a range of conditions representative of site operations.
(2) Assessment of the site operations, layout and personnel protection practices to define hazard levels and specific needs for continuing pollutant monitoring.
(3) A continuing pollutant monitoring program focusing on personnel hazards.

Initially a three day monitoring program was conducted in which critical operating personnel utilizing personal monitors and several fixed locations were examined. Samples from these personnel and area monitors were analyzed to identify and quantify exposures. Once identification of all exposure components was made, air sampling using portable sample pumps and adsorbent composite cartridges was performed. Thirty two highly volatile contaminants were identified. Of these, 13 chemicals were considered to have been present in significant quantities at one or more locations on site. Table 2 shows the average concentration of 11 of these contaminants in the excavation area on 28, 29 April 1981. The maximum concentration of any of these contaminants never exceeded 8% of the Threshold Limit Value (TLV). It is of concern, however, that the concentration of benzene did

TABLE 2

Average potential personnel contamination in hot zone, 28 and 29 April 1981 for major volatile contaminants

Contaminant	Parts per million
Benzene	0.25
1,2-Dichloroethylene	4.9
Trichloroethylene	0.90
1,1,1-Trichloroethane	1.0
Acetone	7.0
Toluene	3.8
Hexane	1.5
Xylene and isomers	0.5
Nonene	0.4
Methylene chloride	1.9
Methyl ethyl ketone	1.8

exceed the action limit value of 0.5 ppm on one occasion. Benzene is a suspected carcinogen, as is trichloroethylene.

Analysis of the liquid samples indicated the presence of pesticides at levels less than 1 ppm such as:
— 4,4′-DDT,
— Dieldrin,
— Endosulfan-alpha, and
— Heptachlor.

The number and variety of volatile, flammable and/or explosive industrial solvents and petroleum products identified by the analyses underscored concern for the danger of fire or explosion. Although the concentrations detected did not warrant great concern, several factors suggested that continuous explosion monitoring was necessary:

1. Ignition sources are necessarily present during site excavation operations (metal grapplers scraping drum surfaces can create sparks, for example)
2. Depth of the trench, combined with calm winds, and pools of volatile, flammable liquids could possibly result in conditions conducive to ignition.

Based on these findings, equipment was purchased and deployed to continuously monitor explosivity and oxygen levels and to provide alarm capability for such conditions. The equipment was portable so that both detection and alarm capabilities could be readily moved as trench operations were moved. At the same time, the decontamination and clean zones were evaluated for levels of contamination. No significant amounts of chemicals were detected.

A meteorological station was employed to record wind speed and direction. Such data could be useful in determining conditions under which the highest level of contamination would be encountered.

The program concluded that, in terms of individual TLV's, there was no significant risk to human health in the operational zones for personnel adher-

TABLE 3

Maximum concentrations (PPM — Parts of operationally defined per million) detected in the air zones

Chemical contaminants detected	Zones: Hot zone: Personnel			Station		Decon zone	Clean zone		Threshold limit value
	Excavation	Pumping	Supervisor	Excavation	Pumping	Com. post	Off site yard	Swamp	
Pentane	0.30	0.02	0.01	0.15	ND	0.05	ND	ND	500
Hexanes	4.4	2.2	2.5	1.9	ND	3.9	0.64	1.2	500
Heptene	0.56	ND	ND	0.10	1.0	0.009	ND	ND	—
Heptane	0.74	0.40	0.33	ND	1.0	0.07	ND	ND	500
Octanes	1.0	0.79	0.68	0.79	ND	0.35	ND	ND	400
Nonene	0.82	0.41	0.51	0.11	ND	0.44	0.005	ND	—
Nonanes	0.95	0.68	0.68	0.31	ND	0.033	ND	ND	—
Other aliphatic hydrocarbons	0.33	0.41	0.25	0.05	0.06	0.05	ND	ND	—
Acetone	20.9	3.5	5.2	3.0	0.45	3.0	0.51	3.5	1000
Methyl ethyl ketone	5.9	1.2	1.2	2.9	0.42	1.5	1.0	ND	200
Methyl isobutyl ketone	7.73	0.54	1.57	1.1	0.08	0.35	0.016	ND	100
Freon 113	0.57	0.04	ND	0.096	ND	ND	ND	ND	1000
Dichloroethylene	6.33	1.7	7.8	3.3	ND	2.1	0.14	ND	200
1,1,1-Trichloroethane	0.81	0.61	1.8	4.0	ND	0.055	ND	ND	350
Methylene chloride	5.8	1.5	1.20	4.86	0.27	1.15	1.4	ND	500
Chloroform	ND	ND	ND	0.68	ND	ND	ND	0.1	10
Trichloroethylene	1.9	0.92	0.75	0.70	0.11	0.11	ND	ND	100
Ethanol	ND	ND	ND	ND	ND	0.29	0.17	ND	—
Methyl methanylate	0.51	ND	0.10	0.008	ND	ND	ND	ND	100
Isophorone	0.071	ND	0.045	0.036	0.008	0.04	ND	ND	10
Benzene	0.56	0.38	0.55	0.34	0.04	0.028	ND	ND	25
Toluene	7.60	4.22	5.56	4.1	0.13	0.93	0.24	0.007	100
Xylanes and ethyl benzenes	1.66	2.7	0.78	0.94	0.25	0.009	0.018	ND	100
Propylbenzenes and isomers	0.72	0.01	0.28	0.26	0.007	0.04	ND	ND	
Butylbenzenes and isomers	0.19	ND	0.02	0.34	ND	ND	ND	ND	
Styrene	0.58	ND	0.045	0.31	ND	0.007	ND	ND	100
Methylstyrene or isomer	0.28	ND	ND	0.007	ND	ND	ND	ND	100
Dichlorobenzene	0.11	0.014	ND	0.94	ND	ND	ND	ND	50
Benzaldehyde	0.05	ND	0.04	0.65	ND	0.04	ND	0.02	—
Naphthalene	0.016	ND	0.009	0.022	ND	ND	ND	ND	10
Phenol	0.033	ND	ND	0.83	0.012	0.08	ND	0.02	5
Cellosolve acetate	ND	1.3	ND	ND	ND	ND	ND	ND	

ing to the required safety precautions. The concern that non-protected personnel outside the work area in the "clean" zones would be exposed to excessive levels was not supported since measurements of contaminants in the decontamination and clean zones indicated that in no instance were TLV's approached (Table 3).

Based upon these results, the degree of contamination off-site could be considered safe. However, it is recognized that odor thresholds are well below TLV's, and even the limits of laboratory detection. Nevertheless, odor complaints from area residents increased throughout the excavation phase and into the summer months. Presumably the complaints were based upon increasing quantities of exposed chemicals which tended to volatilize more readily in hot weather.

Discussion

Limitations in the air monitoring program as well as problems associated with the interpretations of data generated from the study should be mentioned.

(1) Budgetary requirements limited the scope of the study from the outset. Thus it was decided to focus monitoring effects on the contaminated area with specific attention being concentrated on worker exposure and personal protective equipment and other safety equipment needs.

(2) Off-site monitoring of the affected residential areas was considered, but again budget limits prevented a systematic approach. Isolated samples taken off-site indicated the presence of contaminants (Table 3, off-site yard). However, this program was unable to adequately address the problems of off-site odor exposures or potential health impacts on the populace.

(3) As executed, the existing programs did not attempt to examine the synergistic effects of the combined pollutants that workers were exposed to.

(4) The data presented in Table 3 were average, not maximum, exposures. As has been mentioned, the action level for benzene was exceeded on one occasion. It is conceivable, therefore, that maximum exposure levels for other selected chemicals could have been exceeded.

(5) No attempt was made to correlate recorded personnel exposures with the contents (based on lab analysis) of barrels being handled or with the contents of the pools of leachate.

(6) There are other modes of exposure that air monitoring does not record: ingestion and absorption. A means of measuring these kinds of exposures is a medical monitoring program, which was conducted. However, it is an untapped source of data in this program.

Operational problems

Analytical backlog

One of the most important problem areas associated with the excavation and disposal of hazardous waste from this site involved the time required to collect, field screen and analyze the more than 2000 samples taken to allow for the disposal of the hazardous wastes at licensed hazardous waste treatment or disposal facilities. Typically, this process took in excess of two weeks to complete, and backlogs for PCB analysis increased that time up to one month. Various schemes and methods were tried in order to reduce this turnaround time bottleneck. These alternatives included additional personnel, overtime, various sample compositing schemes and providing the disposal companies with samples for their own analysis.

In researching the extent of the problem, it was determined that RIDEM is not alone in experiencing sampling and analysis turnaround time delays. It appears to be an almost universal phenomenon. The basic problem is lack of commercially avaliable gas chromatography (GC) instrumentation time. Only four firms in Rhode Island were found to have analytical capability in the area of hazardous waste. One solution to this appears to be for hazardous waste cleanup contractors to make the capital investments in portable laboratories with GC or gas chromatograph/mass spectrometer (GCMS) capability which could be set up on site and dedicated to the project for the duration of the contract. While this would undoubtedly involve additional daily cost, an assessment should be made as to the overall project cost savings in the areas of sample transportation to off-site labs and shorter total project time. Such an assessment would include concerns regarding sample type, contamination and volumes, personnel, equipment needs and support (e.g., utilities) costs.

Funding logistics

A second problem area experienced by the RIDEM in regard to the effectiveness and timeliness of the cleanup effort at the Picillo site involved the whole issue of funding for the project. Funding has come from three sources to date and the availability of monies to continue the work effort on site has been sporadic at best. This presents obvious planning and scheduling problems in regard to long range plans for a phased removal operation. Equally important is the question of cost efficiency which is raised when the on-site work cannot continue in a steady uninterrupted manner due to budget cuts and funding uncertainties. Considerable sums of money are required to mobilize a contractor at a remote location such as the Picillo site; earth moving equipment and pumping equipment fixed costs continue whether the equipment is operating or idle. These costs eventually are borne by the RIDEM either directly as downtime or indirectly in increased contractor rates.

Contractual agreement

Another concern of the agency/department responsible for the cost effective cleanup of hazardous waste site relates to contract methods and procedures. As is customary in construction engineering practice, elaborate plans and specifications are produced spelling out in minute detail exactly what is to be accomplished and which standard methods are to be employed. The contractor is given little or no latitude as to construction methods or work schedule. Progress is easily measured and completion of the project is easily verified. A hazardous waste cleanup project presents a different challenge. Standard methods are not in widespread use and while some standard lab procedures and safety standards are in existence, work plans must be developed for each site activity on a case-by-case basis an what hazardous materials are encountered. Each contractor brings his own unique perspective and company policy and procedures in regard to working conditions and safety issues. The contractor's on-site work effort can be considered to be more in the realm of professional services as opposed to construction contract services. Thus, contract documents should be developed as a result of requests for proposals rather than bids. This creates basic problems of contract administration and cost control. A more specific scope of work would increase overall project and cost control but reduce flexibility and stifle contractor creativity in developing and implementing improved work methods and procedures.

Safety

Safety issues are of primary concern as they relate to the excavation, sampling, storage, transportation and ultimate disposal of hazardous waste materials. If an unlimited supply of money were made available, ultimate safety procedures could be instituted. Every drum could be handled and sampled remotely by means of mechanical devices and robots. Continuous automated monitoring for explosivity, oxygen content, organic vapor content, and other known contaminants could be performed utilizing remote samplers and gas chromatography. Any automatic alarm system could be utilized and a cessation of the work effort and site evacuation could take place each time an alarm condition arose. But the pace would be agonizingly slow and experience to date has shown that the vast majority of the wastes at the site do not fall into the extremely hazardous categories of explosive, shock sensitive or extremely toxic which would require such careful handling and become excessively costly. The materials found are primarily: highly flammable waste solvents, acids, pesticides and PCB's. Operating within the confines of a limited budget, safety must be addressed and every reasonable effort must be made to afford safe working conditions. However, in the field of hazardous waste cleanup, a risk-free environment is not possible. Even if ultimate safety measures were affordable and put into practice, risks would be reduced but not eliminated. The safety related practices and procedures put into effect at the Picillo site included: remote handling of all drums in the excavation area; constant monitoring of the excavation trench area for explosivity and oxygen content of the work area utilizing various portable meters, including explosimeter, oxygen meter and portable organic vapor analyzer, periodic monitoring of the contaminated zone, decontamination zone, command post and off-site areas for airborne contaminants; utilization of self contained breathing apparatus for all personnel involved in excavation and material handling. Every person in the work areawas equipped with chemically resistant coveralls, rubber gloves and boots, hard hats, goggles or other eye protection as well as a cartridge or cannister type filter repsirator. In addition to this, tests have been completed attempting to define the effectiveness of personnel protection using chemical dosimeters which are available to measure exposure to a number of particular chemicals as well as total organic vapor exposure. All personnel were advised to adhere to strict decontamination and were included in a medical monitoring program.

Contaminated soil disposal

An additional problem area involves the logistics sampling and costs associated with the disposal of contaminated soil generated primarily during the excavation of the northeast trench and to a lesser extent the excavation of the northwest trench. Continuous leachate pumping utilizing a 1000 gallon vacuum pumping unit greatly reduced the amount of soil contaminated during the northwest trench excavation. However, considerable quantities (approximately 10,000 cubic yards) of soil contaminated with organic solvents and PCB's remain on site awaiting final disposition through disposal, or on site fixation or treatment. Estimates for off site transportation and disposal are in the range of one million dollars. Currently EPA is funding a research project which is attempting to destroy the PCB content utilizing sodium polyethylene glycolate [3].

Citizen involvement

Citizen participation which was originally perceived as a problem developed into an asset. The involvement of concerned citizens groups in the planning process and the dissemination of information as to the progress toward project goals is an absolute necessity when dealings with the sensitive and often emotional matters associated with hazardous wastes. An informal community relations plan was developed including local input into the planning process, briefings at citizen group meetings, scheduled weekly access to the site for all interested community and press representatives as well as periodic briefings for local (town) officials and press releases. The concerned citizens group developed into a valuable resource with regard to developing site historical information and providing accurate lists of local affected population in addition to communicating information regarding progress and site conditions to the affected population.

Summary

The cleanup of unauthorized hazardous waste sites presents varied operational and environmental problems. This paper attempts to provide insight into the chronology, operational techniques, air monitoring aspects and problem areas associated with the abatement of such a site situated in Rhode Island.

Field and off-site disposal analyses proved to be a problem in terms of turnaround time and procedural techniques. Particular attention must be paid to the analytical requirements so that they keep pace with excavation efforts and provide the required disposal analyses in a timely fashion.

One of the primary operational constraints involves reducing the risk of injury and adverse health effects to personnel working on site and the surrounding population. A key aspect of this risk reduction strategy involved monitoring the atmosphere on site to assess the degree of hazard in the following areas: explosion, oxygen deficiency and exposure to contaminants. Much of this risk can be reduced on site by the use of self-contained breathing apparatus. But at some distance away from the contaminated zone, respiratory protection must be removed and the air considered to be clean. Unanswered questions at this point include the possibility of long term effects posed to those workers not utilizing respiratory protection (in the clean zone) as well as the effects on the local population.

Funding of a project of this scope must account for the significant unknown factors associated with hazardous wast cleanup, i.e., What is the amount and type of material to be excavated and disposed of?

Every attempt must be made closely monitor contractual obligations. Thorough negotiations and understanding prior to commencement of a project will reduce problems later on.

No hazardous waste disposal activity can be risk free. Therefore, safety precautions are paramount. Yet budget limitations are real and require consideration of the trade-off between risk immunization and performance efficiencies.

The generation of contaminated soil poses a significant disposal problem. Successful efforts were made to limit this problem in Phase II in terms of the smaller amount of generated contaminated soil. However, at some point a disposal option must be chosen to deal with this problem.

Finally, and most importantly, all activities should be closely coordinated with any citizens organization or affected group that deals with the issues of hazardous wastes. An informed citizenry can aid procurement of funding and maintain the necessary interest in the issue that influences governmental decisions. Working closely with such organizations promotes cleanup effects, maintains good press relations and may accelerate completion of the job.

References

1 Hazardous waste investigation: Picillo Property, Coventry, Rhode Island, the MITRE Corporation, Metreck Division, Bedford, MA, April 1980.
2 Final report: Pollutant at the Picillo dumpsite phases I, II and III, June 29, 1981, S & D Engineering Services, Inc., East Brunswick, NY 08816.
3 Unpublished research, Franklin Research Institute.